

CALADENIA CALCICOLA (ORCHIDACEAE), A NEW SPECIES FROM VICTORIA, AUSTRALIA

by

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ABSTRACT

Carr, G. W. *Caladenia calcicola* (Orchidaceae) a new species from Victoria, Australia. *Muelleria* 6(3):185-191 (1986). — A new spider-orchid, *Caladenia calcicola* G. W. Carr (sect. *Calonema* Benth.), an endemic in far south-west Victoria, Australia, is described and figured. It has affinities with *C. reticulata* Fitzg., to which it is compared. The distribution, ecology and conservation status of the new species is discussed.

TAXONOMY

Caladenia calcicola G. W. Carr, sp. nov.

Ex affinitate *C. reticulatae* R. D. Fitzg., sed in proprietatibus sequentibus differt: floribus parvioribus; segmento quoque perianthii nitenti, superficie lineam mediam atro-rubram ferenti; labello parvo rubro nitenti, a dentibus paucis brevibus marginalibus atque callis brevibus congestis truncatulis 4 (interdum 6)-seriatis praedito; columna rubra.

Herb perennating from a globular to ellipsoid, annually-renewed tuberoid to 12 mm diam. *Stem* subterranean, to c. 10 cm long; tuberoids and stem invested in dense, finely-fibrous, long-persistent, brown tunic from previous tuberoid and stem tissue. *Leaf* subtended by an opposite, membranous, closed-cylindrical, minutely mucronate, truncate bract. *Leaf* hirsute, solitary, basal, erect or ascending, lanceolate to linear-lanceolate, to 13 cm long x 1.5 cm wide, acute, often partly withered at anthesis; abaxial surface basally green and irregularly blotched or spotted red-purple, the whole surface densely hirsute with \pm patent straight to slightly retrorse, uniseriate, eglandular trichomes to 10 mm long; basal cell of trichome barrel-shaped to terete, minutely rugose, white-opaque, then with 1-5 extremely fine transparent cells; adaxial leaf surface less densely hirsute with smaller trichomes. *Scape* (7-)13-22(-28) cm long, 1.0-2.5 mm diam., arising at centre of leaf, rigidly erect, straight to slightly flexuose, green or reddish, hirsute throughout with \pm patent, eglandular trichomes similar to leaf trichomes and also with shorter glandular trichomes scattered above the middle, increasing in density upwards. *Glandular trichomes* similar to eglandular ones, but each terminated by a minute dark red spherical cell. *Sterile bract* near middle of scape slightly spreading, narrow-lanceolate, subulate, acute, (12-)15-20(-25) mm x (2.5-)4-5(-8.5) mm, externally hirsute, internally glabrous, with involute margins. *Floral bract* similar, (2.5-)5-6(-8.5) mm x (4.0-)4.5-6.0(-8.5) mm; margins less inrolled, embracing the pedicel. *Flower* 1(-2), rather small, scented with a relatively weak, sweet floral fragrance with a pungent animal-like overtone; scent only perceptible above c. 20°C. *Pedicel* (4-)10-15(-24) mm long. *Ovary* fusiforme, (4-)6-8(-11) mm long, 2-3 mm diam., densely hirsute with short eglandular and (mostly) glandular patent or retrorse trichomes. *Perianth* stiffly spreading; base of sepals sparsely glandular-hirsute externally. *Dorsal sepal* erect, (21-)23-28(-36) mm long, (1.5-)2.0-2.5(-3) mm wide near base, strongly curved forward, linear-acuminate, narrowed to a channelled cauda 0.5-0.8 mm wide; dorsal sepal pale-yellow (RHS Yellow Group 2C in brightest specimens) with distinct deep red (close to RHS Greyed-Purple Group 187C) median stripe within and a narrower median stripe and irregular streaks on outside of sepal; sepal usually glossy within, terminated by a linear osmophore† ('club') (3-)4-6(-9) mm

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† The term "osmophore", a scent-producing gland (Dressler 1981), is preferred to "club" (widely used in *Caladenia* literature) because it emphasises the functional significance of this organ. Stoutamire (1983) showed that the osmophores in pseudocopulatory *Caladenia* species emit sexual pheromones to attract male wasp pollinators.

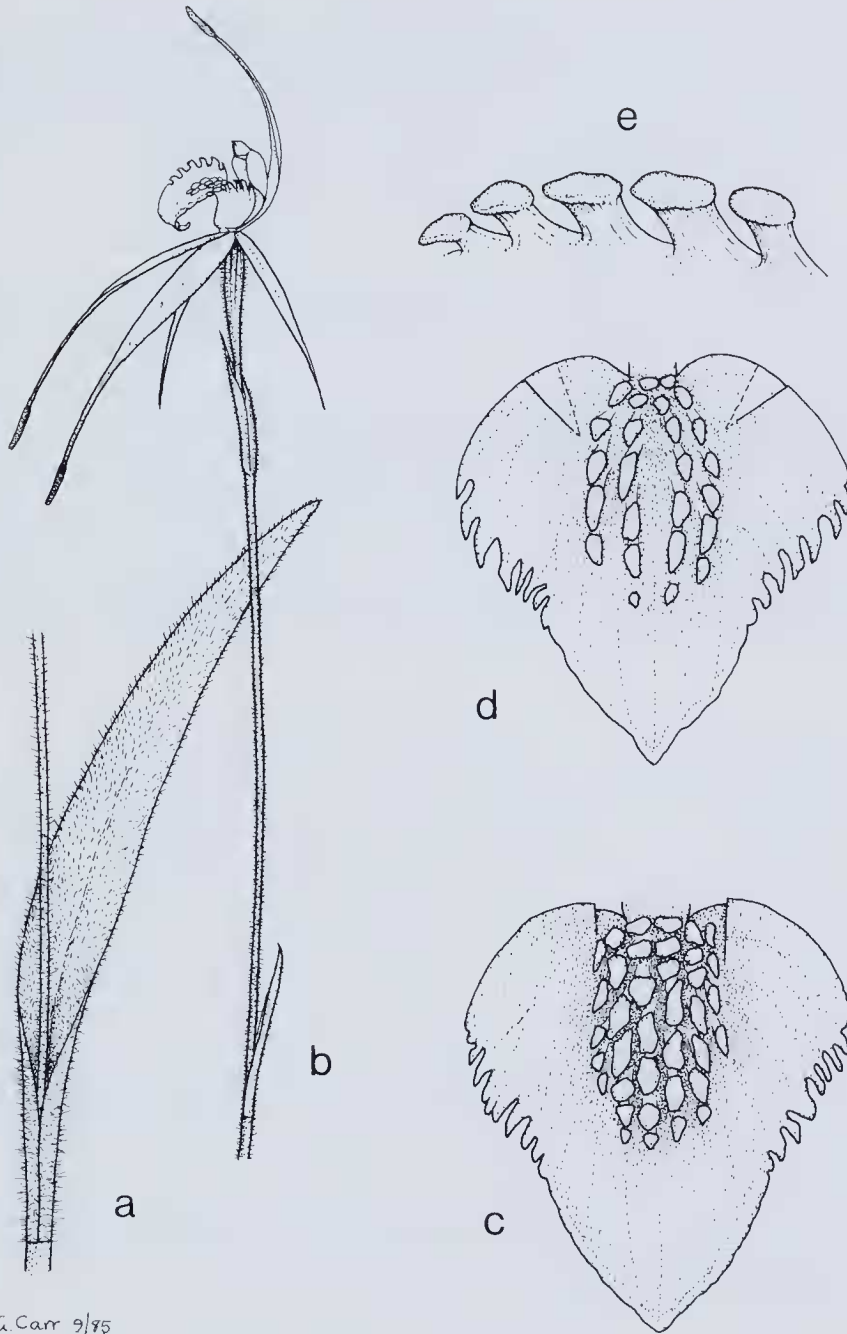
long x 0.6-1.2 mm wide; osmophore often downturned, consisting of minute, densely-packed, yellowish- to reddish-purple, sessile, glandular cells (RHS Greyed-Orange Group 166 A — Greyed-Purple Group 187 A). *Lateral sepals* (17-)25-33 (-40) mm long, deflexed at angle of c. 45°, slightly falcate with \pm flat ovate-lanceolate lamina (1.5-)3.5-4.5(-5) mm wide, \pm abruptly tapering into a very narrow channelled cauda (5-)8-10(-13.5) mm long x 0.4-1.0 mm minimum width; osmophore similar to that of the dorsal sepal, often upturned, (2.2-)4.5-5(-6) mm x (0.3-)0.6-0.8(-1) mm. Lateral sepals similar in colour to dorsal sepal, median stripe above broad, greater than half the width of sepal, narrowly striped below along median line and often irregularly streaked, usually glossy. *Petals* narrow linear-lanceolate, flat, evenly tapering to very fine points, (16-)18-23(-25) mm x (1.5-)2-2.5(-5.3) mm wide, slightly arcuate, from \pm horizontal to deflexed to c. 45°; colour similar to that of the lateral sepals but red median stripe above and below extending to margins above the middle; petals often the most intensely coloured part of the perianth, glossy. *Labellum* articulated on a short claw (\pm 1 x 1 mm), cordate at base, ovate-rhomboid when flattened, (8-)10-12(-15) mm x (7-)8-10(-11) mm, car-nose, very firm and waxy in texture, unevenly curved throughout, projected forward and somewhat flattened above the middle, finally strongly recurved; margin of labellum with (6-)7-9(-10) thick, angular-truncate, rounded or sub-acute antrorse teeth about the middle; teeth up to 1 mm long; apex of labellum entire, gibbous. *Calli of labellum* \pm congested, often touching, in 4(-6) longitudinal rows in a basal median zone (5-)8-11 mm long x (2.2-)2.5-3.5(-4.5) mm wide; inner 2 rows each with (4-)5-8(-9) calli, adjacent 2 rows each with 5-8(-9), outer rows (where 6 rows are present) with 1-3 calli each; calli mostly short-stalked, becoming sessile towards apex, (1-)1.5-2.2(-2.5) mm high near base of labellum, the ultimate ones 0.2-0.3 mm high; head of calli broad, flat-topped, either \pm circular, ovate, elliptical or teardrop-shaped when viewed from above. *Lamina of labellum* red like petals, at least in distal half, marginal teeth and apex very dark red (RHS Greyed-Purple 166 A); proximal half of labellum usually paler red or yellowish-cream, with prominent dark red striations along veins above and below; calli pale to dark red, yellowish-red, or dark with paler colour at centre of head, often prominently contrasting with lamina in basal half; labellum very glossy and waxy in texture. *Column* erect but strongly curved forward, (6.5-)8.5-10 mm high, 4-5 mm wide viewed from front, with 2 prominent rounded swollen yellow glands about 1 mm long on the inner base; axis \pm 1.5 mm wide, narrowly winged below, expanding upward into thick rounded incurved and cucullate wings 2-3 mm wide; *anther* terminal, blunt, 2-2.5 x 2 mm, with a minute terminal apiculus to 0.5 mm long; anther flaps green and pale yellow usually heavily suffused with dark red; *pollinia* 4, flat, \pm irregularly triangular. *Column wings* transparent, \pm deep red throughout or colourless with numerous red striations; axis red dorsally, red or green with numerous reddish striations within; column glossy and waxy in texture. *Stigma* large, c. 2 mm diam., green and glistening, immediately behind anther, circular, centrally depressed; viscidium very narrow, c. 1.5 mm long, touching anther flaps. *Capsule* (absent from type collection) turgid, broadly fusiform, to 16 mm long x 6.5 mm diam., \pm chartaceous at dehiscence. *Seeds* grey-brown.

TYPE COLLECTION:

Bat's Ridges, c. 10 km west of Portland, Victoria, 38°20'30" S.; 141°29'03" E., Victorian plant grid E21, 13.x.1984, G. W. Carr 10049 (HOLOTYPE: MEL 1537340. ISOTYPES: AD, CANB, CBG, PERTH, also spirit specimens AD, CANB, MEL.

SELECTED SPECIMENS EXAMINED (total number examined, 7):

Victoria — Portland, 17.x.1934, F. Mellblom s.n. (MEL 579794, ex herb W. H. Nicholls). Portland, x.1935, G. Lyell s.n. (MEL 574287). Gorae West [in error, actually Bats Ridge], 21.x.1943, A. C. Beaglehole s.n. (MEL 579768, ex herb W. H. Nicholls). F. Davies Hill, Cashmore, 38°19' S., 141°29' E., 28.x.1983, C. & D. Woolcock 1285 (MEL 654791).



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Fig. 1. *Caladenia calcicola*. a — leaf and lower scape, x 1. b — scape and flower, x 1.2. c and d — labellum (flattened, and thus artificially folded along the proximal margin), x 5. e — oblique view of inner row of calli from the labellum (excluding the basal two calli), x 10. a from living plant collected at the type locality and maintained in cultivation. b from colour transparency of plant at type locality. c and e from isotype (AD). d from isotype (CANB).

DISTRIBUTION:

Known only from the Bats Ridge area approximately ten kilometres west of Portland in far south-west Victoria. Local botanists C. & D. Woolcock and A. C. Beauglehole (pers. comm.) have never observed the species elsewhere in the region. *Woolcock 1285* is from an area adjoining the eastern boundary of the Bats Ridge Wildlife Reserve (Woolcock, pers. comm.). The "Portland" locality of some collections almost certainly refers to Bats Ridge.

ECOLOGY:

Occurs on very well-drained, shallow, sandy, terra rossa loams (pH 7.7, A1 soil horizon), on low ridges overlying limestone. Tuberooids are often situated amongst rocks. The limestone is the Miocene Port Campbell formation which outcrops in south-west Victoria and south-eastern South Australia (Abele *et al.* 1976).

The natural vegetation at the Bats Ridge type locality has been partly cleared, grazed by stock and weed-invaded but is remarkably species-rich. A total of 63 native and 26 naturalized vascular species were recorded from a 10 x 10 m quadrat. Principal structural dominants of the vegetation were *Acacia sophorae*, *Eucalyptus viminalis*, *Lepidosperma canescens* and *Leucopogon parviflorus*. Other important native species included *Acacia pycnantha*, *Acrotriche affinis*, *Bursaria spinosa*, *Caladenia latifolia*, *Clematis microphylla*, *Helichrysum apiculatum*, *Hibbertia sericea*, *Lomandra filiformis*, *L. glauca*, *Pimelea glauca*, *Pododthea angustifolia*, *Pterostylis foliata*, *Scaevola pallida*, *Senecio lautus*, *Themeda australis* and *Viola hederacea* ssp. *seppeltiana* (nomenclature follows Forbes *et al.* (1984)).

AFFINITIES AND BIOLOGY:

Caladenia calcicola is most closely related to *C. reticulata* Fitzg., from which it is distinguished by the floral characters given in Table 1. The two species apparently also differ in their habitat preferences, thus phytosociological attributes, in the sense of Izco (1980), are likely to provide useful distinctions.

Distributions of *C. calcicola* and *C. reticulata* do not overlap. *C. calcicola* occurs on limestone ridges on shallow terra rossa soils and is the only species of *Caladenia* (section *Calonema*) on this limestone. Downslope these soils grade into deep siliceous Tertiary sands carrying woodland dominated by *Eucalyptus baxteri* with a heathy understorey. *Caladenia reticulata* occurs on the sandy soils in at least two localities at the foot of the southern slope of Bats Ridge (Carr pers. observation; Woolcock pers. comm.).

It is perhaps surprising that this distinctive species has been overlooked for so long, as several orchid specialists including W. H. Nicholls saw collections of *C. calcicola*. The species was illustrated in Woolcock & Woolcock (1984) under the name *C. reticulata* where the habitat note "sandy limestone ridges" refers to the Bats Ridge locality of *C. calcicola*.

Differences between *C. calcicola* and *C. reticulata* are not readily apparent in dried material, where salient features such as colour, texture, glossiness and calli size and shape are lost or obscured. This indicates the importance of viewing living material, or wet collections combined with colour photographs, for effective taxonomic appraisal of *Caladenia*.

Between 5% and 10% of the plants in the populations of *C. calcicola*, observed between 1979 and 1985, were pollinated annually. Pollination is doubtless affected by a thynnid wasp as described for other *Caladenia* (sect. *Calonema*) species (see Stoutamire, 1983). It is predicted that *C. calcicola* and *C. reticulata* will be found to be pollinated by different wasp species as there are considerable differences in flower colour, floral fragrance, labellum size and ornamentation. The flowering season overlaps in these species and for *C. calcicola* extends from mid September to early November, with an early- to mid-October peak.

Table 1. Comparison between *Caladenia calcicola* and *C. reticulata*.

Based on examination of 30 specimens of *C. calcicola* and 35 specimens of *C. reticulata* (MEL and private cultivation). Specimens of the latter derived from throughout its range in Victoria.

	<i>C. calcicola</i>	<i>C. reticulata</i>
scape	to 28 cm	to at least 40 cm
dorsal sepal	(21-)23-28(-36) mm long; osmophore (3-)4-6(-9) mm long, pale yellow to dark red	(25-)30-35(-45) mm long; osmophore (3-)7-11(-20) mm long, dark red
lateral sepals	(17-)25-33(-40) mm long; osmophores (2.2-)4.5-5(-6) mm long	(23-)32-37(-50) mm long; osmophores (3-)6-12(-17) mm long
perianth segments	pale yellow with deep red median stripe(s) on both outer and inner surface; petals nearly wholly red; perianth segments glossy, at least internally	inner surface concolorous, from red to cream; narrow median stripe (if present) on outer surface only, perianth not glossy
labellum	fleshy, rigid, waxy in texture, small, (8-)10-12(-15) x (7-)8-10(-11) mm, unevenly curved, projected forward and somewhat flattened above the middle, finally strongly recurved; wholly deep red to lighter red or deep red grading to pale yellow at base; striated deep red along veins; very glossy above	less fleshy, not waxy, usually larger, evenly curved throughout; usually bicolorous, deep red at apex, the remainder ± creamish and striated red along veins, or wholly red; not glossy.
marginal teeth of labellum	(6-)7-9(-10), to 1 mm long, ± angular-truncate, concolorous	(7-)15-25(-27), the largest to 3 mm or more long, sub-acute, bicolorous.
calli	congested, distant from apex, in 4 (occasionally 6) rows; inner row with about same number of calli as marginal teeth	widely spaced, approaching apex, in 6 (rarely 4) rows; inner row with about same number of calli as marginal teeth.
calli	very shortly stalked, to 2.5 mm high, with broad ± planate heads, concolorous, dark to light yellowish-red, or dark with paler flat surface.	long-stalked, to 3.5 mm high, narrow, bicolorous.
column	small, wings ± deep red and translucent throughout	larger, wings almost colourless
floral fragrance	weak, sweet, with pungent animal-like overtone	strong 'burnt plastic' smell

CONSERVATION STATUS:

A very restricted endemic known with certainty from only about ten square kilometres around the type locality and from private land at Cashmore, several kilometres east of the type area. Around the type locality it exists on public land in the Bats Ridge Wildlife Reserve (several populations) and on adjoining private land. Extant populations are of unknown size. The conservation status according to the code of Leigh *et al.* (1981) is assessed at 2VC.

Caladenia calcicola is one of the rarest and most restricted species of *Caladenia* in Victoria. Its former distribution may have been wider on limestone outcrops (see ecology) in far south-west Victoria and perhaps south-east South Australia. Most of these outcrops have been cleared for agriculture but the species may occur in similar habitat in the Lower Glenelg National Park to the west of Bats Ridge.

The largest population known by me, adjacent to the type locality, was destroyed in 1980-1984 by limestone quarrying operations.

SPECIES CONCEPTS IN CALADENIA (SECTION CALONEMA)

The recognition of *C. calcicola* as a distinct species is based on an evolutionary species concept (Wiley, 1981) to which reproductive isolation is central. This contrasts with the traditional conservative species concepts, often based on inadequate

material and lack of field knowledge of taxa, which prevailed before the reproductive biology and pollination system in *Caladenia* (section *Calonema*) were known.

Stoutamire (1974, 1975, 1983) showed that pseudocopulation is a basic pollination syndrome in *Caladenia* (section *Calonema*). Male thynnid wasps are attracted to flowers for sexual rewards. Unpublished data collected by the author and M. A. Clements (pers. comm.) support these findings.

On the available evidence it is very likely that mechanisms involved in *Caladenia* pollination parallel those involved in the pollination of the Mediterranean orchid genus *Ophrys*. The model developed for *Ophrys* pollination by Kullenberg (1961), Kullenberg and Bergström (1976) and Bergström (1978) indicates that olfactory, tactile and visual stimuli lead to behaviour in male aculeate hymenoptera which affects pollination. The olfactory stimulus is the primary and independent stimulus and tactile and visual stimuli are secondary and dependent (Bergström, 1978).

Concerning the taxonomic appraisal of *Caladenia* (section *Calonema*) in the context of an evolutionary species concept, weight is placed on morphological and other criteria hitherto overlooked or ignored in a traditional species concept. This accounts for the detailed description of *C. calcicola* presented here. Taxonomic criteria include habitat (ecology), trichome characters, floral fragrance, colour of floral organs and detailed comparative morphology of floral parts. The functional significance, however, of some of the morphological features (e.g. marginal ornamentation of labellum, presence of two basal glandular processes on the inside of the column) is not yet known.

In traditional concepts variation in a number of characters was often considered to be continuous in polymorphic assemblages, e.g. colour and relative sizes of floral parts. This is rarely the case and where it does exist introgression may often explain this variation (Carr, unpublished data).

It is considered that the primary mechanism for speciation in pseudocopulatory *Caladenia* is likely to be segregation of a biochemical isolate differing in floral fragrance (i.e. sexual pheromones). This would be capable of attracting a different species of pollinating insect. Pollinator-mediated selection pressures would then lead to morphological differentiation as a consequence of the crucial role of visual and tactile stimuli in the pollination process.

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REFERENCES

- Abele, C., Kenley, P. R., Holdgate, G. & Ripper, P. (1976). Otway Basin. In Douglas, J. G. & Ferguson, J. A. (eds), 'Geology of Victoria.' (Geological Society of Australia: Melbourne).
- Bergström, G. (1978). Role of volatile chemicals in *Ophrys* — pollinator interactions. In Harbourn, J. B. (ed.), 'Biochemical Aspects of Plant and Animal Co-evolution.' (Academic Press: New York).
- Dressler, R. L. (1981). 'The Orchids. Natural History and Classification.' (Harvard University Press: Massachusetts).
- Forbes, S. J., Gullan, P. K., Kilgour, R. A. and Powell, M. A. (1984). 'A Census of the Vascular Plants of Victoria.' (National Herbarium of Victoria: Melbourne).
- Izco, J. (1980). The role of phytosociological data in floras and taxonomy. *J. Linn. Soc., Bot.* 80: 179-90.
- Kullenberg, B. (1961). Studies in *Ophrys* pollination. *Zool. Bidrag Uppsala.* 34: 1-340, t. 1-51.
- Kullenberg, B. & Bergström, G. (1976). The pollination of *Ophrys* orchids. *Bot. Not.* 129: 11-19.
- Leigh, J., Briggs, J. & Hartley, W. (1981). Rare or threatened Australian plants. *Austral. Natl Parks and Wildlife Serv. Special Publ.* No. 7.
- Stoutamire, W. P. (1974). Australian terrestrial orchids, thynnid wasps, and pseudocopulation. *Amer. Orch. Soc. Bull.* 43: 13-18.
- Stoutamire, W. P. (1975). Pseudocopulation in Australian terrestrial orchids. *Amer. Orch. Soc. Bull.* 44: 226-33.

- Stoutamire, W. P. (1983). Wasp-pollinated species of *Caladenia* (Orchidaceae) in south-western Australia. *Austral. J. Bot.* 31: 383-94.
- Wiley, E. O. (1981). 'Phylogenetics. The Theory and Practice of Phylogenetic Systematics.' (John Wiley and Sons: New York).
- Woolcock, C. & Woolcock, D. (1984). 'Australian Terrestrial Orchids.' (Thomas Nelson: Melbourne).

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